

## WHAT IS CLAIMED IS:

1. Apparatus for selectively queuing data packets for transmission from at least one of a plurality of sources to a given target over a multiplexed communication path, comprising:

load shaping means responsive to data packet communication path transmission requests from one or more managed devices comprising a class, of device(s) and/or application(s), authorized to transmit data up to at least a given minimum bandwidth in a given operational time period; and

BMC (Bandwidth Management Controller) means operable to maintain a table of BW (Bandwidth) authorized for a class and further operable, in response to each request from one of said load shaping means, to supply at least one more token for permitting at least one further data packet to be transmitted at least up to said BW authorized for each given class.

2. Apparatus as claimed in claim 1, comprising, in addition:

communication path usage monitoring means operable to permit said BMC to supply tokens to requesting load shaping means that exceed the class authorized BW, for a given operational period, when the communication path is being utilized at less than a given percentage of capacity.

3. A method of maximizing usage of a multiplexed communication path between best efforts data sources and data from at least one of a plurality of sources of a given priority class, comprising:

maintaining a compilation of information as to classes of data sources authorized to have priority in a given time period of operation along with authorized minimum BW (Bandwidth) for

each class and allowable additional standby BW for each class;  
placing a class ID (identification) request for at least  
one additional transmission token from a centralized controller  
having access to said compilation of information, as each data  
5 packet is placed in a unique class queue, corresponding to said  
class ID, to be transmitted;

providing additional transmission tokens, as requested, for  
each authorized class ID, up to the total of authorized minimum  
BW and presently allowable standby BW; and

10 adjusting allowable standby BW for each class as an inverse  
function of present total communication path utilization for  
both priority and best efforts data packets.

4. The method of claim 3, comprising, in addition:  
15 normally maintaining at least a predetermined minimum BW  
for all best efforts data packets queued for transmission.

5. A method of using a multiplexed communication path,  
comprising:

20 providing separate data path transmission queues, of source  
initiated data packets, within each of a plurality of  
multiplexed communication path queue managers, for best efforts  
data packets and each separately identified and authorized class  
of managed data sources, the BW (Bandwidth) of each class being  
25 centrally controlled;

managing the bandwidth allowed in a given operational time  
period by supplying an additional class specific token from a  
BMC (Bandwidth Management Controller) to a requesting path queue  
manager to replace a given class token used by said path queue  
30 manager when placing a managed source data packet in queue for  
transmission, additional class specific tokens being supplied up  
to a total limit of authorized and standby values maintained by

said BMC for each operational time period; and  
adjusting said standby values downwardly as a function of  
detected congestion in said multiplexed communication path.

5        6. Apparatus for queuing arbitration for a computerized  
payload transport network, comprising:

BMC (Bandwidth Management Controller) means operable to  
issue requested class specific base and standby tokens, the  
standby tokens being a function of transport network congestion;

10       a plurality of load shaper means, connected to a payload  
transport network for queuing both best effort and managed class  
specific data packets in separate queues for network transport;  
and

15       class specific queuing means, comprising a part of at least  
some of said load shaper means, for requesting a replacement  
class specific token, as each token is used in connection with  
placing a data packet in queue for transmission over said  
transport network

20       7. Apparatus for queuing arbitration for a computerized  
payload transport network, comprising:

shaper means for comparing payload class against class  
restriction status; and

25       BMC (Bandwidth Management Controller) means interconnected  
to said shaper means for managing base tokens and standby  
tokens.

30       8. A method of managing BW (Bandwidth) allowed given data  
packet sources in a multiplexed communication path  
interconnecting a plurality of sources and targets, comprising;  
maintaining a table of base and standby BWs available for  
each of a plurality of managed source classes; and

adjusting the presently allowable BW as a function of communication path congestion.

9. The method of claim 8, wherein:

5 the standby BW available is exponentially reduced when congestion is detected; and

the available standby BW is linearly increased in a periodic manner when the communication path is not congested.

10 10. Apparatus for priority queuing data packet transmissions over a communication path, comprising:

a plurality of distributed bus request queue managers at least some of which include load shaper portions operable to establish separate class identified queues having priority over  
15 best effort data packet queues; and

BMC (Bandwidth Management Controller) operable to distribute base tokens to said load shaper requesting same whereby a plurality of distributed sources can share a common class allocation of guaranteed BW in accessing a common  
20 resource.

11. Apparatus of claim 10, comprising, in addition:

communication path utilization monitoring means; and

standby means, operating in conjunction with said BMC and  
25 said communication path utilization monitoring means, to increase BW for at least some classes above the guaranteed BW by distributing standby tokens, in addition to the base tokens, when the communication path is under-utilized.

30 12. A method of giving at least authorized BW (Bandwidth) priority communication path access to a class of data packet network distributed sources, comprising:

maintaining a centralized count of class specific data packet tokens distributed where each data packet token represents a definable portion of authorized BW;

requesting an additional replacement token from a  
5 centralized token source interconnected with means for maintaining the centralized count when a data packet from a given one of said distributed sources is placed in queue for transfer on said communication path; and

supplying additional replacement token(s) upon request  
10 until the authorized BW is used up in a given operational time period.

13. The method of claim 12, comprising, in addition:

maintaining an allowable standby count for each authorized  
15 class wherein the standby count is dynamically adjusted in accordance with communication path congestion; and

supplying additional replacement token(s) upon request until both the authorized BW token count and the standby count, for the class of token requested, are used up in a given  
20 operational time period.

14. A method of communication path activity BW (Bandwidth) management in a multi-computer system for use by a plurality of BW managed and BW unmanaged entities wishing to transmit data  
25 over said path, comprising:

submitting a request, from a BW managed first entity, for a given bandwidth to an assignment entity;

assigning a unique class identity and a designated allowable BW from said assignment entity;

30 supplying said assigned unique class identity and designated allowable BW from said assignment entity to load shaping entities interconnected to said communication path, by

said assignment entity, of acceptance of said requested BW by said first entity;

5 sending data packets from said first entity to said load shaping entity for transmission on a bus attended by said load shaping entity, each of said data packets providing class priority information including said unique identity;

10 allocating a given number N of time slots commensurate with said designated BW, for use over a predetermined number of time slots, for use by said first entity for as long as said first entity continues to supply said data packets for transmission; and

15 permitting transmission of data packets over said bus by unmanaged entities when no managed BW entity data packets await transmission.

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15. A computer program product for giving at least authorized BW (Bandwidth) priority communication path access to a class of data packet network distributed sources, the computer program product having a medium with a computer program embodied thereon, the computer program comprising:

20 computer code for maintaining a centralized count of class specific data packet tokens distributed where each data packet token represents a definable portion of authorized BW;

25 computer code for requesting an additional replacement token from a centralized token source interconnected with means for maintaining the centralized count when a data packet from a given one of said distributed sources is placed in queue for transfer on said communication path; and

30 computer code for supplying additional replacement token(s) upon request until the authorized BW is used up in a given operational time period.

16. A computer program product for maximizing use of a multiplexed communication path, the computer program product having a medium with a computer program embodied thereon, the computer program comprising:

5 computer code for providing separate data path transmission queues, of source initiated data packets, within each of a plurality of multiplexed communication path queue managers, for best efforts data packets and each separately identified and authorized class of managed data sources, the BW (Bandwidth) of  
10 each class being centrally controlled;

computer code for managing the bandwidth allowed in a given operational time period by supplying an additional class specific token from a BMC (Bandwidth Management Controller) to a requesting path queue manager to replace a given class token  
15 used by said path queue manager when placing a managed source data packet in queue for transmission, additional class specific tokens being supplied up to a total limit of authorized and standby values maintained by said BMC for each operational time period; and

20 computer code for adjusting said standby values downwardly as a function of detected congestion in said multiplexed communication path.